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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

In the Matter of)
)
Revision of the Commission's Rules) CC Docket No. 94-102
To Ensure Compatibility with) RM-8143
Enhanced 911 Emergency Calling Systems)

To: The Commission

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COMMENTS OF ASSOCIATED RT, INC.,
A SUBSIDIARY OF THE ASSOCIATED GROUP, INC.
TO THE FURTHER NOTICE OF PROPOSED RULEMAKING

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SUMMARY

Associated RT, Inc. ("ART"), a wholly owned subsidiary of The Associated Group, Inc. and a leader in cellular telephone location systems, has been a very active supporter of the efforts of the Commission and industry organizations leading up to the Report and Order in CC Docket No. 94-102. However, at this time, ART cannot support the Commission's proposal in the Further Notice of Proposed Rulemaking to change the location accuracy requirement to 40-feet in three dimensions, 90 percent of the time because such technology has not yet been developed. Instead of a mandate now, the Commission can instead adopt policies that can stimulate and accelerate continued development towards a 40-foot goal. ART supports the Commission's proposal to provide location information within 5 seconds of a call, and provides information requested by the Commission on the costs of various proposals.

The Commission's decision in the Report and Order to require location systems to meet a 410-foot, 67 percent two dimension location accuracy standard within five years had a proven technology basis and is immediately achievable. However, the establishment of an exceedingly more stringent post 5-year location standard of 40-foot accuracy, 90 percent of the time using three dimensions is both unnecessary and counterproductive at this point in time, and may delay the rollout of location systems meeting the Report and Order. Furthermore, the proposed

post 5-year accuracy standard has no firm technological or economic foundation.

There are significant technologic hurdles that location system developers must overcome to achieve 40-feet, 90 percent due to the inherent characteristics of cellular and PCS signals and to the high multipath characteristics of many urban and suburban cities. Some technologic solutions may prove to be more expensive than some '911' authorities are willing to bear. For example, the density of location receiving sites may increase by a factor of 4 or more over that required for 410-foot systems. In addition, new antennae, new algorithms, and significant greater processing power may be required to achieve greater accuracy. The current deployment of 410-foot systems does not preclude future upgrades to higher accuracy systems, as the receiver hardware used for the location systems will likely remain constant.

A mandate cannot assure technical success, but the Commission can encourage location developers to strive for 40-feet, 90-percent systems through the creation of appropriate incentives. One incentive strongly recommended by ART is limiting the number of air interfaces for which emergency services deployment is required to only AMPS, which is the only ubiquitous air interface standard that is available in every market and to every cellular and PCS subscriber via dual-mode, dual-band phones. AMPS is the only interface for which the Commission can assure a cellular or PCS subscriber that their call to '911' will go through. No digital interface is uniformly available

throughout the United States. AMPS also has the longest deployed history in the U.S., and has the most complete coverage.

A second proposed incentive is establishment of a two-tier cost recovery mechanism for the deployment of location networks. The Commission could continue to require a 410-foot location accuracy standard for all CMRS, while setting the 40-foot requirement as an optional requirement that would be implemented only if requested and funded by the requesting emergency service authorities. Third, the Commission could attempt to establish minimum cost recovery thresholds for 40-foot location accuracy systems to address the market risk that a system satisfying such an accuracy standard may be so costly as to cause emergency service providers to elect not to fund the deployment of such systems.

As a further accelerant to the deployment of location systems, the Commission should revise its rules to allow entities other than the wireless carriers with the technology and resources to assume the responsibility and be compensated for constructing and deploying the '911' ALI systems. The willingness of some entities with available resources would counter the reluctance of some of carriers to deploy location systems sooner rather than later.

ART supports the proposal to provide location information within 5 seconds of a '911' call, and further clarifies the proposal to state that the 5-second timer should begin when the caller dials "911 SEND". This is necessary to provide critical location information prior to routing a wireless '911' call to

the appropriate PSAP. Technology is currently available to provide location information to meet this proposal. Furthermore, it is also technically possible to continue updating location during a '911' call provided that technical cooperation exists between wireless switches and location systems.

Associated is not aware of the present existence of any location system for cellular or PCS telephones that meets a horizontal or vertical standard of 40-feet, 90 percent. It is therefore impossible to accurately predict what the cost of such systems might be. However, ART can estimate that the cost of a two-dimensional 40-foot, 90 percent system would be a multiple of 4 to 10 times greater than the cost of a 410-foot, 67 percent system. The cost of a three-dimensional, 40-foot system would be about twice the cost of a two-dimensional, 40-foot system.

ART firmly believes that the Commission has a duty to adopt policies that will promote and accelerate the provision of improved wireless E911 services. The existence of conflicting multiple standards, and even the ongoing discussion of multiple standards (i.e. 410-foot, 67-percent; 410-foot, 90-percent; 40-foot, 90-percent) will serve to confuse both developers and carriers, and may create stagnation rather than enthusiasm in the efforts to proceed with near-term implementation of nationwide delivery of wireless E911. Therefore, rather than promoting a moving target, the Commission should reaffirm its Report and Order and make the requirements unambiguous.

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TO THE FURTHER NOTICE OF PROPOSED RULEMAKING**

Associated RT, Inc. ("ART"), by its attorney, herein comments on the Further Notice of Proposed Rulemaking ("Further Notice") portion of the Report and Order and Further Notice of Proposed Rulemaking released on July 26, 1996 in the above-captioned proceeding (hereinafter "Report and Order" or "Further Notice" as appropriate).¹

As the Commission is aware, ART has been and continues to be very active in the development of 'E911' location systems.² Since ART's last participation in this docket, it has announced a commercial field trial of its TruePosition™ Cellular Location System in connection with a cellular telephone system operated by Comcast Cellular Communications, Inc. and with the '911' system operated by the state of New Jersey. The service trial will span a 50-mile stretch of the New Jersey Turnpike, including

¹CC Docket No. 94-102, FCC 96-264, released July 26, 1996.

²See Comments of The Associated Group, Inc. filed January 9, 1995; Reply Comments of Associated RT, Inc. filed March 17, 1995; Reply Comments of Associated RT, Inc. filed March 11, 1996.

Burlington, Camden, Gloucester and Salem counties. Installation of the TruePosition system is well underway and the trial is expected to commence in the near future.

In addition, ART will also be installing a trial system in Houston, Texas in connection with a cellular system operated by Houston Cellular Telephone Company (jointly owned by AT&T Wireless Services, Inc. and BellSouth Corp.) and with the '911' system operated by Greater Harris County 9-1-1 Network. The trial for this system should also commence in the near future.

INTRODUCTION

In the Report and Order, the Commission established, among other matters, requirements for deployment of automatic location information ("ALI") systems. Specifically, the Commission concluded that within five years of the effective date of the Report and Order, covered carriers are required to achieve the capability to identify the latitude and longitude of a mobile unit making a '911' call within a radius of no more than 125 meters (410-feet) in 67 percent of all cases.³

In the Further Notice, the Commission has proposed several important changes to the requirements for deployment of ALI systems which have significant, but as yet unquantified policy and economic implications for the industry. Among these changes, the Commission proposes that five years after the effective date of the Report and Order, covered carriers will be required to

³Report and Order at ¶ 71.

achieve the capability to identify the latitude and longitude of a mobile unit making a '911' call within a radius of no more than 12 meters (40-feet) in 90 percent of all cases. ART submits that such a proposal is prima facie inconsistent with the five-year location standards adopted by the Commission in the Report and Order, and that it is both unnecessary and counterproductive to adopt such a proposal at this point in time. Therefore, for the reasons discussed herein, ART urges the Commission to defer action on these proposed changes until the industry has time to adequately demonstrate its ability to meet the standards established in the Report and Order within the five year period and to advance the state of technology such that ALI systems can deliver a more accurate location service in an economically feasible manner.

I. COMMISSION POLICIES SHOULD PROMOTE, AND NOT DELAY, IMPROVED WIRELESS E911 SERVICE

The Commission has a duty to adopt policies that will promote and accelerate the provision of improved wireless 'E911' services. ART has serious concerns that a number of the changes proposed by the Commission in the Further Notice will not promote, and may actually delay the delivery of the very services strongly supported by the Commission in the Report and Order. In particular, by proposing several changes to the accuracy standard, the Commission will divert attention and resources away from systems that already meet, or are currently in development

to meet, the 410-foot, 67-percent requirement of the Report and Order. Furthermore, the existence of conflicting multiple standards, even the ongoing discussion of multiple standards (i.e. 410-foot, 67-percent; 410-foot, 90-percent; 40-foot, 90-percent), will serve to confuse both developers and carriers, and may create stagnation rather than enthusiasm in the efforts to proceed with near-term implementation of nationwide delivery of wireless 'E911'.

A. A Moving Location Accuracy Target Will Delay Deployment Of Location Systems.

The Commission asks whether "establishing [the post-five-year accuracy standard at 40-feet, 90 percent of the time] now, rather than at a later time closer to the end of the five-year period, will act as an incentive to spur continuing efforts to develop improved location information technologies."⁴ ART believes that the Commission's efforts to expedite the development of improved should be addressed, but not in the manner proposed in the Further Notice.

By forcing the industry's attention to turn towards what a post-five year standard should be before the industry has even begun to implement the mandates of the Report and Order can only serve to confuse and delay the rollout of ALI systems incorporating the five-year accuracy standard. Rather than mandating the development and implementation of location systems

⁴Further Notice at ¶ 137.

meeting the 410-foot, 67 percent accuracy standard in the near term, the Commission's proposal may encourage the industry to delay the development of ALI systems until well into the future to determine *when and if* technology will advance to the point of meeting a 40-foot, 90 percent mandate in an economically viable manner. As ART discusses later in these Comments, there are great technical challenges to delivering a 40-foot, 90-percent system that have not yet been addressed by the industry. This technical uncertainty serves only to further amplify any policy uncertainty and actually provides carriers with a potential justification for delaying the implementation of location systems, contrary to the interests of public policy.

The Commission should appreciate that development of interfaces and products necessary to support the presently known 12 air interface standards is still underway.⁵ Some of these air interfaces are still being initially deployed at the present time and it is not clear whether the current 5 year time horizon can be met for all 12 air interfaces. This is especially true in the case of several digital interfaces which are still undergoing development and field trials of their basic communications capabilities.⁶ Location systems cannot be readily developed for

⁵These interfaces are AMPS, NAMPS, TDMA, E-TDMA, CDMA, ESMR, PCS 1900, Composite CDMA/TDMA, DACS, Wideband CDMA, GSM, and CDPD.

⁶Recent press reports indicate an ongoing concern with digital interfaces. For example, the September 6, 1996 edition of Telecommunications Alert stated as follows:

(continued...)

any radio-based system until the radio system is field deployed and relatively stable. Although ART expects that all 12 of the air interfaces can be satisfied by 410-foot location systems at some undetermined point in the future, it would retard and make more costly the development of such systems if the Commission forces developers to focus on a horizon goal of 40-foot accuracy. Besides increased development costs, as discussed elsewhere in these comments, there may be significant deployment cost differences between 410-foot systems and 40-foot systems.

Therefore, ART urges the Commission to refrain from making the 5-year accuracy goal a moving target. ART and others have made significant investments in developing technology in anticipatory support of the standards adopted in the Report and Order. Based upon the joint industry efforts at the Joint Expert Meetings in 1994, the commentary discussion in the proceeding in

⁶(...continued)

Code division multiple CDMA), a digital wireless system for voice and data traffic, is coming under fire from experts who say that the technology is overdue and subpar. Once forecast to be the standard for wireless services in the future, the technology is stumbling along at a slow pace, losing ground to other digital services, time division multiple access (TDMA), and the global system for mobile communications (GSM). Although CDMA promises higher capacity than either technology, it has yet to be rolled out in significant quantity. Problems with signal strength have kept it in the development stage for nearly seven years, with the exception of small trials in Hong Kong and Los Angeles. Users of the system say that it is improving, although it tends to drop calls, just like the GSM technology.

See also America's Network, July 1, 1996 at page 26.

1995, and the Consensus Agreement in 1996, a 410-foot requirement has been much anticipated and products are ready for deployment now. If the Commission remains solidly behind this requirement, implementations of location systems can begin immediately. ART anticipates that some wireless carriers will desire the competitive edge of a location system deployed immediately, while others may wait most of the 5 year window. If the Commission desires that the wireless end-user community begin receiving the benefits of location systems as soon as possible, then the Commission should reaffirm its Report and Order and make the requirement unambiguous.

B. As The Only Ubiquitous Air Interface, AMPS Should Be The Standard For E911 Service.

If the Commission is seeking to adopt policies that will promote and accelerate the deployment of high quality location systems for wireless 'E911', then the Commission should consider mandating AMPS as the single air interface to be used for all calls to '911'. Location systems are already available for AMPS that can meet the mandate of the Report and Order, while the availability of location systems for other air interfaces is still uncertain as discussed earlier. In addition, if the Commission desires that the accuracy and quality of deployed location systems improves over time, then the Commission should encourage the industry to concentrate its financial and human resources on a single goal.

When the Commission first created the cellular band, AMPS was mandated as the single air interface to promote ubiquity across the United States. Therefore, a user purchasing a telephone in one city could travel across the country and be able to obtain cellular service in any other city. This notion of a single air interface standard was then also adopted by Canada and Mexico, further enabling cellular users the freedom to travel throughout North America and be able to place a call, including an emergency call to "911" at any place, and any time.

The Commission has since adopted policies that permit cellular and Personal Communications Services ("PCS") licensees to deploy radio systems with digital air interfaces. This has encouraged much innovation and the provision of new services not previously possible using the original analog AMPS radio systems. While these policies were properly intended to ultimately increase diversity in the types of services to be made available to the consumer, it has also complicated the development and deployment of location systems for 'E911' by increasing the number of air interfaces that have to be accommodated as well as the cost of accommodating them. The Commission must separate the commercial benefits of offering many new services to end-users from the need to quickly locate the end-users in an emergency situation, when life and safety are at risk.

Under the Report and Order, there may be as many 7 separate location networks required for a given market, counting potential

cellular, PCS, and Enhanced Specialized Mobile Radio ("ESMR") providers. If a given total wireless subscriber base were to contribute '911' surcharge fees to a "911 pool" of funds, and this pool were used to build 7 separate location overlay systems, this would necessarily dilute the potential quality of each location system. If the Commission were to require all wireless handsets to support AMPS, and if AMPS were used for all '911' calls, then the surcharge fees collected from all sources could be devoted to the development and implementation of two higher quality networks (i.e. the current wireline and non-wireline cellular operators). Since the Report and Order requires cellular carriers to pass all '911' calls without validation, roaming agreements between the various digital cellular, PCS, and ESMR providers would not be required.

Carriers already acknowledge that even though great sums are being spent on deployment of digital systems, AMPS will continue to be available and play a large role well into the future. According to AirTouch Communications, an early and avid CDMA proponent: "Even in a world which is predominantly digital, AMPS will occupy a large percentage of the cellular band..."⁷

Under this proposal, location system developers could concentrate all development efforts into a single air interface standard rather than 12 separate air interfaces. The likelihood

⁷AirTouch Communications, "The Economics of Smart Antennas and Wideband Digital Base Stations", presented at the Center for Telecommunications, Stanford University, July 20, 1995.

of achieving improved accuracy (i.e. better than 410-feet, and perhaps eventually near 40-feet) in a desired timeframe will improve, and the economic ability of emergency service providers to fund more accurate systems in desired areas is also enhanced.

This proposal would be consistent with the current activities of most carriers today. Given that AMPS is the only air interface available everywhere in the U.S., many digital cellular and PCS phones already support dual-mode and dual-band functionality⁸. Dual-mode refers to the ability to support a digital air interface and AMPS in the same phone. Dual-band refers to the ability to support 800 MHz AMPS and 1800 MHz PCS in the same phone. The digital cellular protocols support commands that enable a hand-off to AMPS in mid-call. Therefore, this proposed policy would not likely alter the functionality of already deployed digital phones. It may only require relatively simple programming changes to wireless switches to always hand a '911' call off to an AMPS radio.

C. Further Analysis Must Determine Whether The Additional Benefits Of The Proposed Policy Will Exceed The Increased Costs.

In the Further Notice, the Commission has requested information on the costs to deploy both 40-foot, 90-percent location systems and location systems capable of a vertical (altitude) dimension. However, the Commission has not solicited

⁸For example, in the September, 1996 issue of *Cellular Business*, pp 42-43, Ericsson describes their dual-mode, dual-band phone.

comments on whether the benefits of these improved systems will exceed the costs, or even how to compare the benefits and costs. A relatively limited number of commenters in the first Notice of Proposed Rulemaking requested these additional features.⁹ The broader industry created and supported a Consensus Agreement that did not include these additional features.¹⁰ As discussed later, the additional costs to support these additional features can be a significant multiple of the costs to meet the Report and Order, and the value of having these additional features is questionable.

D. The Commission Can Benefit From Experience In Commercially Deployed Systems.

While location systems for cellular telephones have been in development for the last several years, no commercial deployments have taken place yet. Extensive field trials have proven the technology, but there will certainly be additional knowledge and experience gained from full scale, system-wide deployments. The

⁹See Joint Comments of Association of Public-Safety Communications Officials-International, Inc., National Emergency Number Association and National Association of State Nine One One Administrators at 42, filed January 9, 1995 in CC Docket No. 94-102 ("[w]e believe this 10-meter requirement is an obtainable goal in the future particularly in the urban areas with corresponding smaller cells."); Comments of Texas Advisory Commission on State Emergency Communications at 10, filed January 9, 1995 in CC Docket No. 94-102 ("believes that the 125 meter 3 dimensional radius is too broad to be of significant usefulness in a multi-story building environment. A ten meter radius would be a better goal, in that it would narrow the location to within three floors in a building.").

¹⁰"Public Safety-Wireless Industry Consensus: Wireless Compatibility Issues, CC Docket 94-102", February 12, 1996.

Commission and the wireless community should wait for these first critical deployments to be installed, debugged, and then field verified with live '911' traffic. The emergency services community should determine from actual use whether 410-foot accuracy works well enough most of the time, or whether an improved accuracy will make a dramatic difference. It is also possible that the emergency community will determine that improved accuracy is needed in only part of a carrier's service area.

ART believes that the location receiver hardware used for a 410-foot system and a more accurate (perhaps eventually 40-foot) system would be identical, and therefore that it is likely that a location system can be upgraded over time to support greater accuracy. Allowing the industry to focus on satisfying the 410-foot, 67 percent standard will not cause built-in obsolescence that will retard a system's ability to undergo a future transition to more accurate location system performance. A 410-foot system already uses high quality receivers. Upgrading the accuracy of a location system to meet an improved standard should not require changes in the type of receiver components of a location, but it may dictate the use of more receivers and increased receiver site density. These issues are discussed later in these Comments.

The Commission should also benefit from experience gained in deployment of location systems for multiple air interfaces. If

the Commission desires to continue to require separate location systems for each air interface, it is important to consider that location systems for digital telephones have not yet been subjected to trials. Although the industry currently believes that digital telephones can be located with accuracy similar to that already demonstrated for analog telephones, it would be unreasonable to equate that belief with fact without field verifying location systems for multiple air interfaces.

E. Mandating Improved Accuracy Targets Will Not Assure Technical Success.

The technical challenges associated with meeting the increased accuracy goals proposed in the Further Notice are great, as discussed later. The adoption by the Commission of these increased accuracy goals may cause the pursuit of these goals by developers in the industry, but at a significant cost and a significant delay of systems. However, the Commission should be reminded that even after such considerable sums of money are spent chasing greater accuracy, the technical challenge may not be met and the desired accuracy goal may not be achievable. For this additional reason, ART urges the Commission to proceed with caution and to assure that the proposed 40-foot, 90-percent standard and the vertical dimension are actually needed and that the required technology is decidedly achievable

in an economically realistic manner before setting such requirements for location systems.¹¹

II. LOCATION INFORMATION IS TIME CRITICAL TO ENHANCED 911 NETWORKS

In the Further Notice, the Commission seeks comment on a proposal by KSI for a latency¹² period of 5 seconds and an updating of the location information every 10 seconds.¹³ ART's experience in working with various emergency service providers is that the period between the time a '911' call is placed and the receipt of the call by the nearest Public Safety Answering Points ("PSAPs") is critical in emergency situations.

For existing landline enhanced '911' networks, there are some jurisdictions in which time periods of only a few seconds (2 to 5 seconds) are permitted from dialing '911' and subsequent ringing at a PSAP. During this time, there are many routing¹⁴ functions required within the landline network built to support

¹¹See JEM Report at 5.1.3 (stating that "within 400 feet" is a "near term goal" and that "within 40 feet" is a "long term goal" and stressing that "[i]t is important to note that these are goals, not requirements. The realization of these goals is contingent on technical and economic feasibility." (emphasis added)).

¹²Latency represents the time period from start of one event and the start of a second event. In this case, latency represents the time period from when the caller dials '911 SEND', and the call is answered by a 911 call-taker.

¹³Further Notice at ¶ 142.

¹⁴Routing involves the selection of the appropriate PSAP to receive the call. This can vary from a choice of only a few to a choice from among hundreds of PSAPs.

enhanced '911'. It is reasonable to apply similar, but not identical, requirements to wireless callers to 'E911'. Specifically, the Commission should require that location information be made available within 5 seconds of a caller dialing "911 SEND" from a wireless telephone.

A. A 5 Second Timer Should Begin When Caller Dials "911 SEND".

Currently, when a wireless caller dials '911 SEND', it generally takes at least 5 seconds from the time that the caller dials '911 SEND' for the wireless network to assign a voice channel, set up communication paths, and route the call to the appropriate '911' tandem¹⁵. If a wireless network is busy, it can take longer, but it usually does not happen quicker than 5 seconds. After these 5+ seconds, the call arrives at the '911' tandem and '911' routing begins. This means that 5+ seconds have elapsed even before the time period for a landline ringing requirement of a few seconds (2 to 5 seconds) would begin. These first 5+ seconds can have a significant impact on the ability of a '911' system to expeditiously route a '911' call to the PSAP most appropriate to the emergency.

When a landline call arrives at the '911' tandem, the caller's phone number is used as the routing criterion. As a

¹⁵In some '911' networks, the device performing the routing is a '911' tandem. In other networks, the device is a selective router. For purposes of this discussion, the functionality of these two devices can be considered identical.

result, identification of the caller's location is almost immediate. However, when a wireless call arrives at the '911' tandem, the caller's location (usually in latitude, longitude coordinates, but other coordinate are also acceptable) will be used as the routing criterion. This means that a location system must provide location information to the '911' tandem prior to or simultaneously with the arrival of the voice call so that the '911' tandem can route the call without delay. This implies a necessary latency of no more than 5 seconds from the dialing of '911 SEND' to the determination of the caller's location and the availability of this location data to the '911' tandem.

If location information were not available at the '911' tandem prior to or simultaneous with the voice call arriving, the '911' tandem would have to rely on a default routing criterion. In one state that ART has studied, there are hundreds of PSAPs but only a handful are used for default routing for cellular calls. Today, because no information is available about the caller prior to speaking with the caller, these few default PSAPs must spend precious time determining the caller's location and then determine the appropriate PSAP to which to transfer the call. The location information must then typically be repeated to the second PSAP accepting the call transfer. Critical seconds can turn into dangerous minutes before police, fire, and ambulances can be dispatched. If the call were properly routed in the first

few seconds, dispatch of emergency help can begin almost immediately.

B. Location Can Be Provided Within 5 Seconds of Dialing "911 SEND".

ART's experience in locating cellular telephones involves initial location determination using time difference of arrival ("TDOA") on the reverse control channel. Using this technology, locations can be determined using an instantaneous (100 millisecond) transmission, rather than averaging for many seconds. ART has found that using the reverse control channel for determination of a caller's initial location has the advantage that location processing can take place in parallel with the call set up taking place in the wireless switch. The location system receives the caller's transmission (that is, the digits '911' being sent over the air interface) simultaneously with the wireless base station, and can begin determining a location before the base station has even assigned the mobile telephone to a voice channel. Therefore, in at least this one technical approach, a location system can meet a 5 seconds from dialing '911 SEND' requirement for a caller's initial location.

C. Regular Updates Are Possible With Technical Cooperation Between Switches And Location Systems.

The Commission is also seeking comment on a proposal to update location information every 10 seconds.¹⁶ ART believes that the need for an update of a caller's location and the time

¹⁶Further Notice at ¶ 142.

interval between such updates is best determined by emergency service providers. However, ART can provide a technical perspective should this functionality be desired. The control channel generally cannot be used to update the location of a caller who is connected with a '911' PSAP. The voice channel must be used. The AMPS voice channel has spectral characteristics (modulation and bandwidth) that are not as advantageous to location systems as the AMPS control channel (this includes consideration of the SAT, speech modulation, and control messages sent over the voice channel). Additionally, the matching of a particular voice transmission to a particular caller is more difficult because no identifying information is contained within the voice channel. A control channel transmission always contains the caller's MIN, as well as other information. The matching of caller's identification with the voice transmission (i.e. radio channel assignment) is best determined from the wireless switch, especially when hand-offs are occurring during a call. While it is possible to determine this information by trying to build a separate network of receivers to follow the hand-off messages, ART believes that this approach is not economical, efficient, or reliable for large numbers of calls and hand-offs.

Therefore, while the updating functionality can be developed and deployed, there are some significant technical challenges to be overcome. Moreover, the location accuracy during each 10